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Influences of Daylighting towards Readers' Satisfaction at Raja Tun Uda Public Library, Shah Alam

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Abstract

Designing library study environment is important to the mood, motivation and performance of individual because interior design plays an important role on human mood and social behaviours. Lighting, as a control architectural tool, gives important influences on users' perception behaviour and visual comfort in libraries. A public library in Shah Alam was chosen as the main subject. . The result found that the library users prefer the seat near daylighted area, but the time spend in the library is not really affected by daylighting. Besides for visual comfort, daylighting is not the only contributor to overall comfort and user's satisfaction.

Keywords: Daylighting; readers' satisfaction; visual comfort; seating preference

1. Introduction

Students usually prefer to study in private rooms or the library. This is because students are able to shut out external stimuli such as noise in private rooms (Hasirci, 2011). For student education, the libraries are important for the student access to permanent information, data sources and documentation records. The design of libraries can enhance or hinder motivation for the student to use them not only during exams, but also in free time. Today, successful libraries are being planned and used more and more as a social gathering places, as well as for deskwork, computer work, group work, reading and browsing through not only books but journals, CDs, DVDs, and other digital sources (Hasirci, 2011). Designing study environment in a library is important to the mood, motivation and performance of

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individual because interior design of a room plays an important role on human mood and social behaviour. Lighting, as a control architectural tool, gives important influences on users' perception behaviour and visual comfort in libraries (Hasirci, 2011).

1.1. Statement of the problem

Most of the designs in building nowadays are lack in the daylighting concept. Daylight is important for the interior space of a building especially to users of the building itself. Building like library is important to have a good day lighting concept for the users' activities and satisfaction.

1.2. Purpose of the study

The purpose of this study is to investigate the daylight in a library and to determine how the daylight in libraries influences the users' satisfaction.

1.3. Aim and objectives of research

The aim of this research is to determine the satisfaction level of users with regards to daylight factors in public libraries. The objective is:

- To know whether daylight affects satisfaction of users in the library.

The main hypotheses are:

- Library users prefer the seat near daylighted area, and they will stay longer.
- Users are more comfortable at the space in library that has efficient daylighting.

1.4. Limitation and delimitation

This study is carried out at the main reading area of the library only. It will be done during day time, and on sunny weather condition because it involved daylighting. The artificial lighting cannot be switched off at the reading area during the measurement and observation because it will disturb the function of the library. The lux meter used to measure the illumination levels at each respective desktop surface inclusive of both the daylighting and the artificial lighting values.

1.5. Importance of the study

The study helps to give an indication of the library users' preferences with regards to daylight availability, hence, provide future designers to design better and efficient seating layout at the reading area. This will encourage people to go to the library and stay longer at the library.

2. Literature Review

2.1. Daylighting

Hasirci (2011) said that daylight gives influences on user's behaviour and perception because daylight is a control architecture tool. Daylight is one of the features that can increase quality and how long someone will stay in a space (Hasirci, 2011). There are three parts of daylight transmitted through windows which are diffuse light, direct transmitted light and redirected transmitted light (Carla Balocco, 2008).

Daylight is variability because as the sun moves, the direction and the amount of daylight enter into the space through the window or roof vary (Dean, 2005). According to Wang and Boubekri (2010) who carried research at University of Illinois at Urbana-Champaign, "sunlight produces sensations of pleasantness and warmth, even in an air-conditioned and thermally comfortable room, people are still attracted to sunlight". It is shows that whether in a space that air-conditioned like the library, people still want to get the sunlight. It will influence the seat preference of people which they will prefer to seat near the windows that can give the sunlight. Wang and Boubekri (2010) had found that most of the people chose to sit close to or within the sun patch, although some arranged their desk back to the window and not having a direct outdoor view.

Daylighting is important to school communities in order to improve their performance. One study from Heschong– Mahone Group in 2002 showed that elementary students in the classrooms with the most daylight improve in learning rates compared to students in the classroom with the least daylight by 21 percent. This result which have important implications for school design, affirm that daylight has a positive and significant influence on student performance (Heschong– Mahone Group, 2002).

In the study of Fontoynont (2001), when there is daylight, occupants will prefer lower artificially illuminated levels. For activities that involve computers, occupant preferred light levels of 100 – 300 *lx*, while it increases to 300 – 600 *lx* for occupants that spent less time on computers (Fontoynont, 2001).

The results of a study by A. Zain-Ahmed et al (2002) have shown that for office spaces in Malaysia climate, if illuminance falls below 500 *lx*, the supplementary lighting is required. While, a normal working environment will not required any artificial lighting at all if the space receive over 5000 *lx* of illumination levels during all months (A. Zain-Ahmed et al, 2002).

2.2. Daylight in library

The average value for any library activities that involve visual task like reading and writing is about 500 *lx,* which in a range between 300 and 750 *lx* (Carla Balocco, 2008).

Reading, task involvement and productivity is largely affected by the amount of daylight. It shows that the effective use of daylight in an educational environment such as the library is important (Hasirci, 2011).

Hasirci (2011) found in his research at the main library of Dundee University, daylight and outside view are important factors for the satisfaction of the users in the library. For their own satisfaction, the users preferred to study under controlled daylight with the help of low partitions. The control daylight which is not too bright and glare, satisfied the users of the library which gives comfort to the users. Some users will avoid direct sunlight while others will ignore direct sunlight in choosing their seat (Hasirci, 2011). It is preferred to have indirect sunlight in libraries. The sunlight that transmit through a window or skylight bring along light and heat energy to the space (Dean, 2005).

The brightness of work area in relation to the rest of the room also affects the amount of time spent in one place in the library (Hasirci, 2011). It was also found that the library users' comments such as, "Daylight is often a factor in my seat choice, but I do not prefer direct sunlight from a window" or "The amount of time spent in the library is mostly related to the amount I need to study, but the amount of daylight can also be a factor may affecting my length of stay" (Hasirci, 2011). It shows that daylight influence seat preference but some people will not prefer the sunlight but some people do. The daylight also affect the amount of time spent in library which is also related to their comfort and satisfaction of the place.

2.3. User's satisfaction

One of the main factors that affect comfort of users is a good lighting and a comfortable chair (Hasirci, 2011). According to a study of Fontoynont and Escuyer (2001), result on analysis of variance showed that occupant's performance in the reading task, the speed and overall efficiency of analogy task are affected by the seating layout. Finding in research at the main library of Dundee University show that the amounts of time spent in a single position in the library have a significant relationship with the users thought that the seat that they choose was designed for maximum use of daylight (Hasirci, 2011). In a study by Cheung and Chung (2008), the main characteristic preferred by the occupants of a residential room is the general brightness and also the desktop brightness with an outside view.

Another factor that influences readers' comfort is the indoor temperature. Even though, most of the public spaces nowadays are air conditioned, the additional solar heat gain through glass openings somehow influence the indoor set temperature, especially near the perimeter windows. In another study by Lawrence Berkeley Labs, in 2009, the decrease in reading speed and comprehension at 81°F, compared to 68°F, was as much as 30 percent. Certain temperatures (not varying due to convection more than 3°F from the floor to five feet high) were better for various age groups. The relative humidity in a space for learning also strongly influences readers' comfort. Readers reported 72°F and 60 percent relative humidity quite acceptable. However, as air temperatures rises, however, the relative humidity should decrease to maintain comfort (Castaldi, 2004).

The users satisfaction towards the library will affect the length of stay in the library, more preferable seat, and they will be able to focus on their activities in one place (Hasirci, 2011).

In the Hasirci (2011) report, one of the users said that the amount he need to study is the main factor that affect the length of stay in the library but the amount of daylight can also be one of the factors.

From the finding of the research, 56% of the users choose to seat near the window, and they remain in one place when study (Hasirci, 2011).

3. Research Method

Research approach for this study is quantitative. One of the public libraries in Shah Alam, which is Perpustakaan Raja Tun Uda is chosen as a case study. The data analysis was determined from the questionnaires replies from the library users and observation around the library. The questionnaire consists of 2 parts, which is daylighting and visual comfort. The existing measurement instrument, which is rating scale to study the user's satisfaction towards day lighting in library, was use in this study. First of all, the seating layout of the library was drawn and included as one of the instruments to collect data in this study.

3.1. Data collection procedure

Questionnaires were given out to the library users. The users were asked to evaluate the importance of each question on 1 to 5 differential scale where "1" meant "strongly disagree" and "5" meant "strongly agree", for the daylighting part. For the visual comfort part, the users were asked to evaluate each question on 1 to 5 also but on the specific situation for each question. Information regarding age, gender, weather condition and time of the day also collected. At the same time, the researcher marked each user's seat preference on the observation sheet which consists of seating layout plan of reading section in the library. The data was collected in the morning, afternoon and evening on the sunny weather condition. Few pictures of the library were taken to provide a visual image and overall mood of the library.

3.2. Data analysis

The result from the questionnaire was calculated to get the average values. The mean of the result will determine whether the daylight at the library affect the seating preferences and the amount of time spent in the library. It will also provide an indication whether the users are satisfied with the level of daylighting which influence the overall visual comfort within the library.

3.3. The scale and location of study

Perpustakaan Raja Tun Uda at Shah Alam city, a public library, is chosen as the study subject. The medium size reading area of 120 seats provide enough useful data for the study. The shape of the reading section is rectangular, with row of windows on the eastern side and atrium on the west.

3.4. Data sources and methods for obtaining relevant data

The data was collected at Perpustakaan Raja Tun Uda in Shah Alam using a questionnaire that was given out to the library users. The observation on the users' seat preference also was made to complete this study.

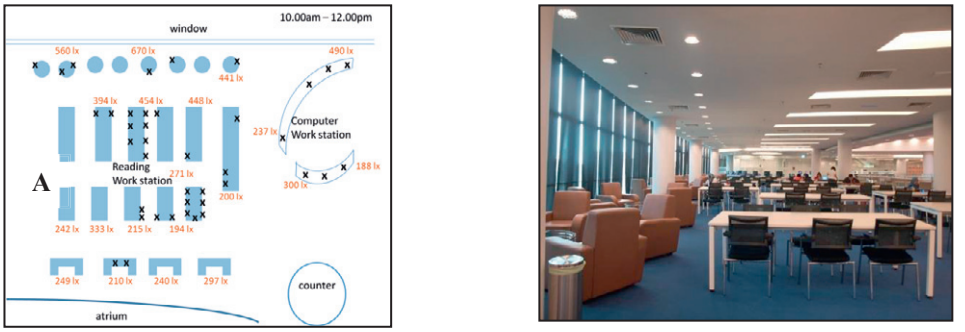

Fig. 1. (a) Location of Position A; (b) The view from Position A

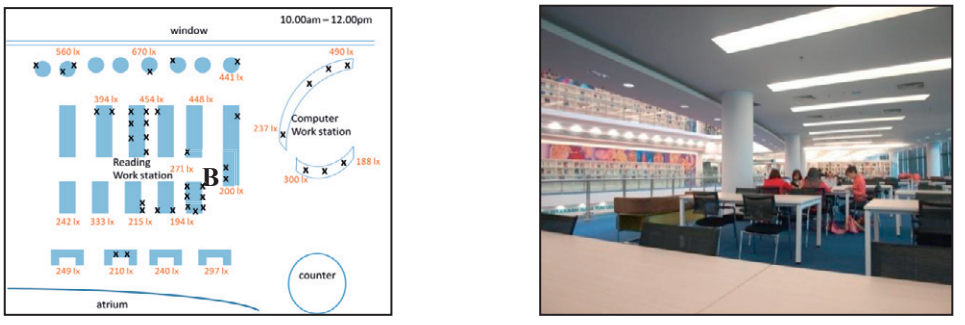

Fig. 2. (a) Location of Position B; (b) The view from Position B

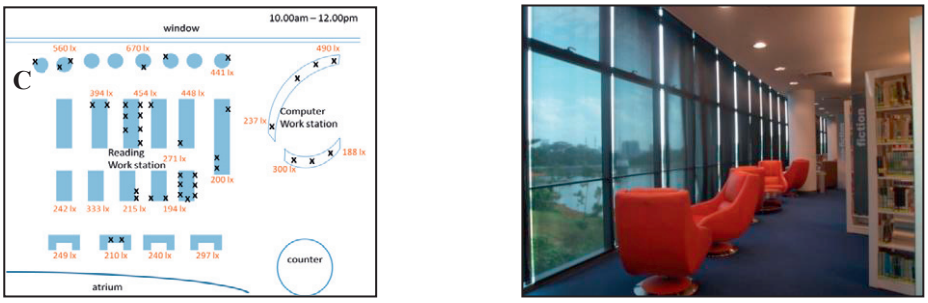

Fig. 3. (a) Location of Position C; (b) The view from Position C

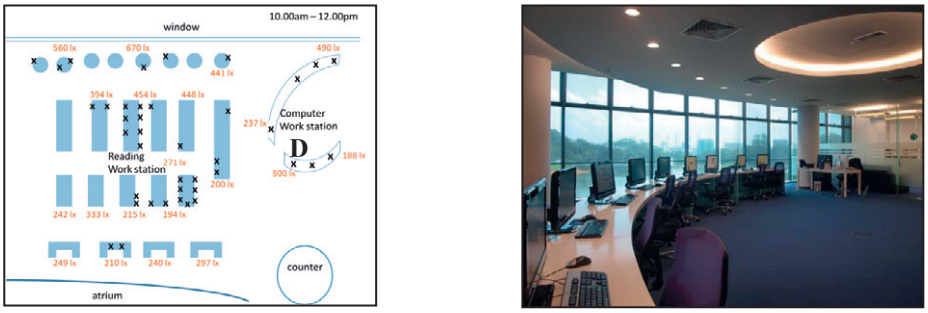

Fig. 4. (a) Location of Position D; (b) The view from Position D

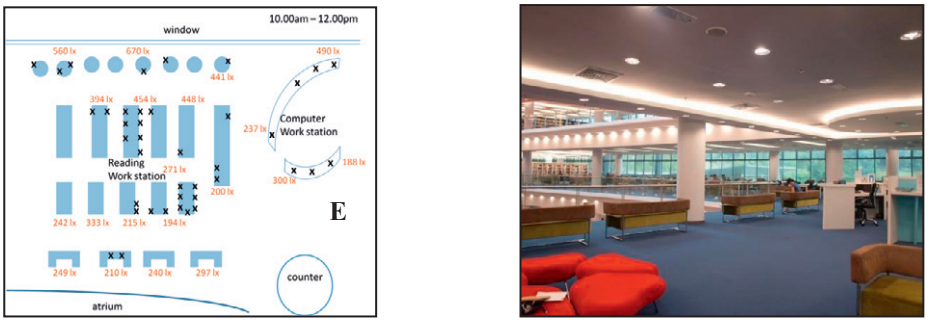

Fig. 5. (a) Location of Position E; (b) The view from Position E

4. Data Analysis and Finding

4.1. Observation

From the observation, user's seating preference in Perpustakaan Raja Tun Uda shows that daylight affected the seating layout of the users in the library. The observation was taken place in three different times in a day, which is from 10.00 am to 12.00 pm (38 respondents), 12.00 pm to 2.00 pm (33 respondents), and 2.00 pm to 4.00 pm (43 respondents). The weather during the observation took place is sunny. The observation shows that the seating preferences were different for the different period of time because of the different amount of daylight at each workspace. The seating preferences and the amount of lighting (in *lx*) for each different time of the day are shown in diagrams below (see Fig. 6 - 8).

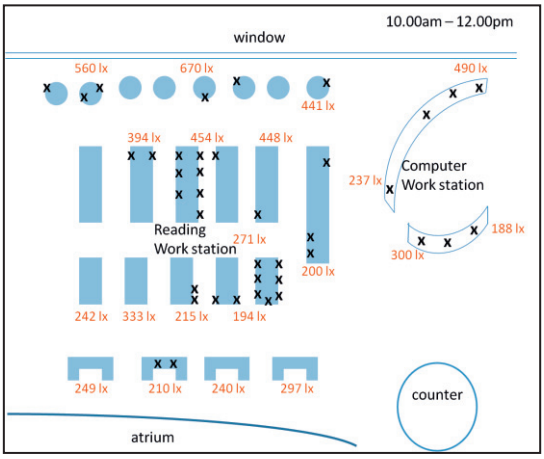

Fig. 6. Pattern of users' seating preferences with lux (illumination) measurement (10.00 am – 12.00 pm)

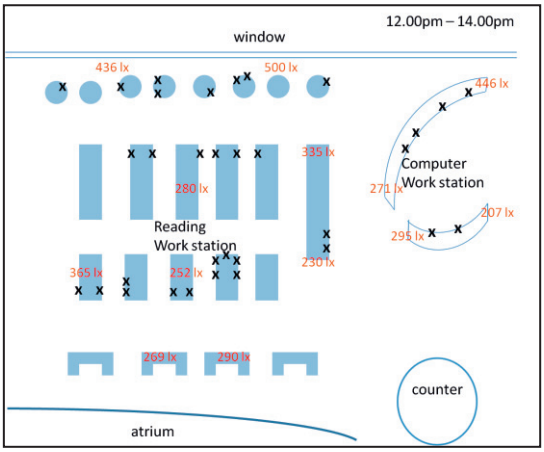

Fig. 7. Pattern of users' seating preferences with lux (illumination) measurement (12.00 pm – 2.00 pm)

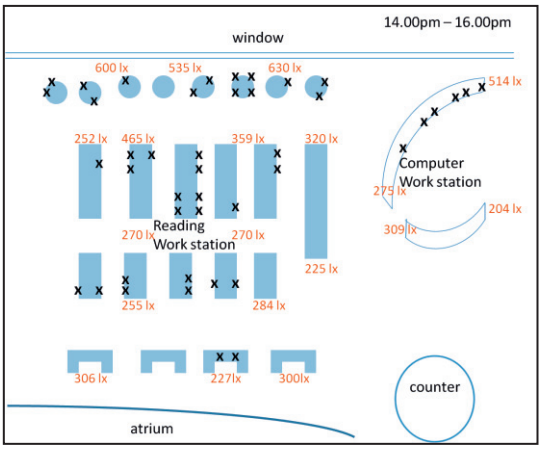

Fig. 8. Pattern of users' seating preferences with lux (illumination) measurement (2.00 pm – 4.00 pm)

This shows that there was a significant relationship between the amount of daylight and the seat chosen by the users of the library. From 10.00 am to 12.00 pm, users prefer to sit at the centre where the amount of light was between 200 *lx* – 450 *lx,* while there were less people sitting near the window where the amount of light was between 560 *lx* – 670 *lx* (Fig. 6). Users prefer to sit near the window and near the atrium with skylight during 12.00 pm to 2.00 pm where the amount of light was between 250 *lx* – 500 *lx* (Fig. 7). During 2.00 pm to 4.00 pm, users of the library sat randomly where they sat at both at the centre and near the window area, and around the atrium of the library (Fig. 8). The average amount of light throughout the whole workspace during 2.00 pm – 4.00 pm was between 230 *lx* – 630 *lx*.

4.2. Questionnaire

4.2.1. Daylight at the library

From the questionnaire, it was found that daylight affects the seating preference of the users. 42% of the respondents agreed that daylight affects their seating preference and 32% of them strongly agreed with it. Therefore, it was more than half of the respondents, where 74% of them agreed that their seating preference affected by the daylight (Fig. 9).

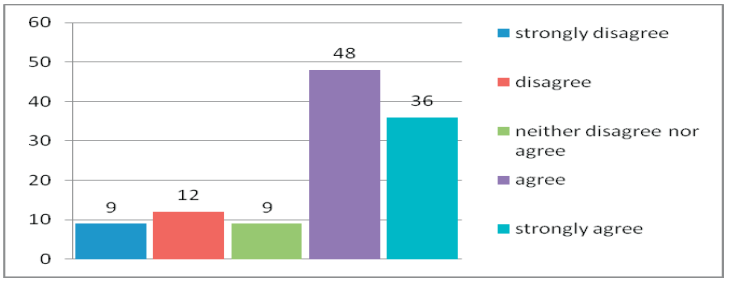

Fig. 9. Daylight affects seating preferences (114 respondents)

There were 32% of the respondents *neither disagree nor agree* with the statement that daylight affects the amount of the time spend in the library. While there were 37% of the respondent disagree that daylight affects the amount of the time spend in the library. Thus, the amount of time spend in the library was not affected by the daylight (Fig.10).

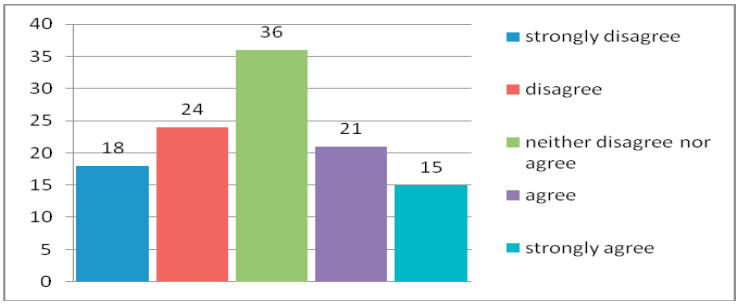

Fig. 10. Daylight affects the amount of time spent in the library (114 respondents)

For Perpustakaan Raja Tun Uda, a huge number of respondents about 68% of them agreed that the design of the seating layout of the library optimizes daylight (Fig. 11).

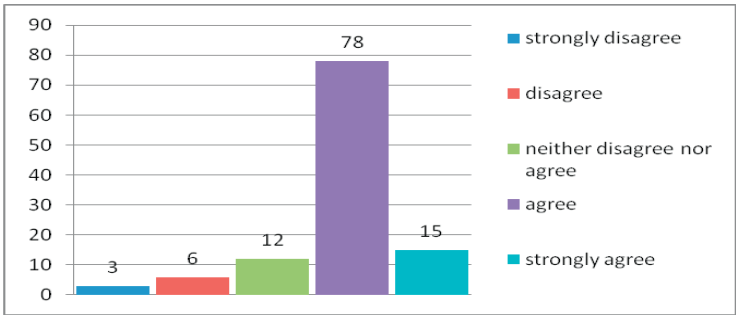

Fig.11. The design of seating layout optimizes daylighting (114 respondents)

There were 37% of the respondents agreed that the design of spaces to move around the library optimizes daylight while 34% of them were *neither disagree nor agree* with it (Fig. 12).

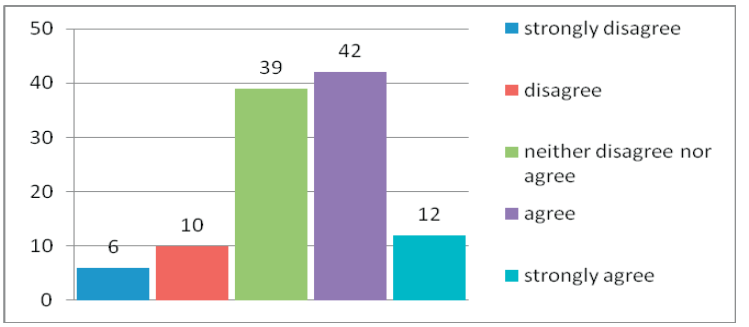

Fig. 12. The design of spaces to move around the library optimizes daylighting (114 respondents)

Almost half of the respondents, which is 45% of them agreed that the arrangement of book shelves in the library optimizes daylight while 39% of them were *neither disagree nor agree* with the statement (Fig. 13).

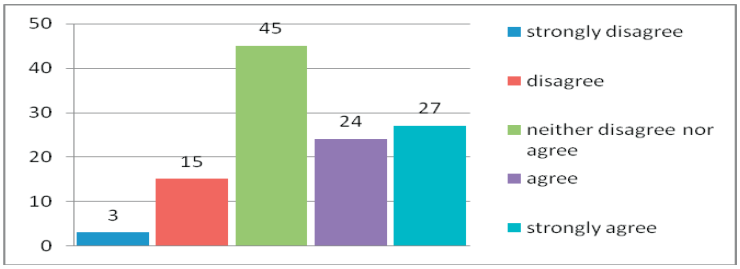

Fig. 13. The arrangement of book shelves optimizes daylighting (114 respondents)

So it can be concluded that the design of the seating layout, circulation area and arrangement of book shelves of Perpustakaan Raja Tun Uda optimizes daylight.

4.2.2. Users' impression of the space

The impression and the personal opinion of the users about the work space in Perpustakaan Raja Tun Uda was taken at three different time of a day that is from 10.00 am to 12.00 pm, 12.00 pm to 2.00 pm and 2.00 pm to 4.00 pm. This is because to observe whether different amount of daylight affected the impression and satisfaction of users about the workspace in the library.

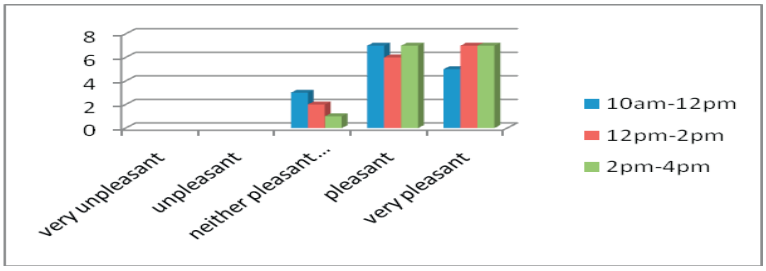

Fig. 14. Users' impression of the space: Pleasantness

In term of pleasantness within the space, the research revealed that the level of respondents' impression increased with time, i.e. averaging from 4.13 (10.00 am – 12.00 pm), to 4.30 (12.00 pm – 2.00 pm), to 4.40 (2.00 pm – 4.00 pm) (see Fig. 14).

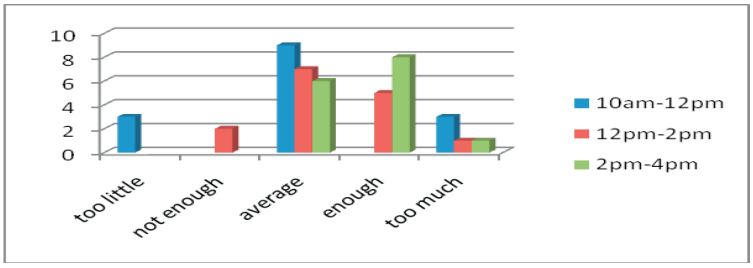

Fig. 15. Users' impression of the space: Daylight availability

Respondent's impression with respects to daylighting availability also increased as time moves from 10.00 am to 4.00 pm. In the 10.00 am – 12.00 pm period, the respondents' level of impression recorded was 3.00, in the 12.00 pm – 2.00 pm period it was 3.33, whilst in the 2.00 pm – 4.00 pm period it was 3.67 (see Fig. 15).

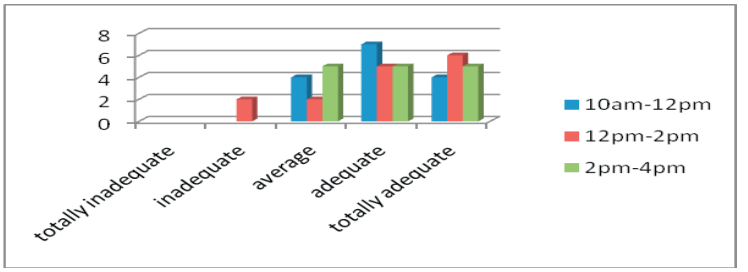

Fig. 16. Daylight availability at the work place: Adequacy

In term of daylight availability (adequacy), average readings from all the respondents in all the three (3) time periods recorded that the amount is *adequate*, and of the same value of 4.00 on all the three (3) time periods (see Fig. 16).

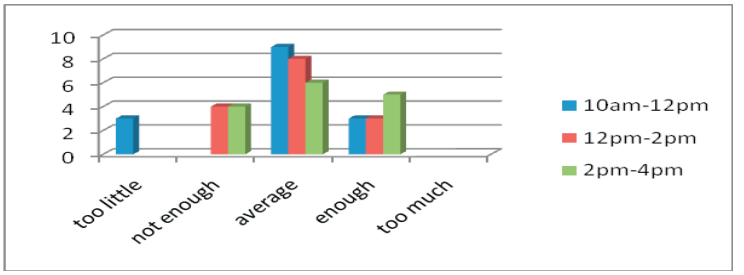

Fig. 17. Daylight availability at the work place: Brightness

In the case of daylight availability (brightness), it seems that level of respondent's impression increased with time. In the 10.00 am – 12.00 pm period, the average respondents' level of impression recorded was 2.80, in the 12.00 pm – 2.00 pm period it was 2.93, whilst in the 2.00 pm – 4.00 pm period it was 3.07 (see Fig. 17).

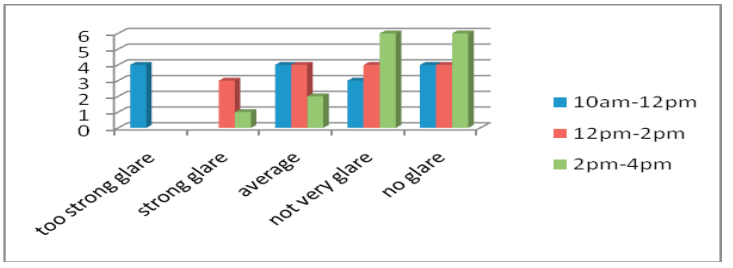

Fig. 18. Glare through windows

Few respondents experienced strong glare, especially those seating close to windows. In the time periods of 10.00 am -12.00 pm and 12.00 pm to 2.00 pm, most of the respondents expressed that the glare level was only *average*, however, in the 2.00 pm – 4.00 pm time period, most of the respondents claimed that the glare level was *not very glare* (see Fig. 18).

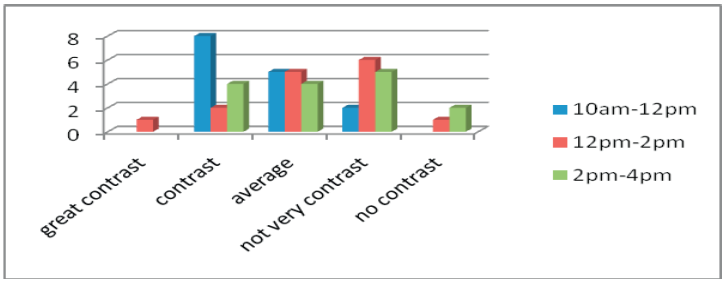

Fig. 19. Brightness contrast between indoor and outdoor

In the time period of 10.00 am – 12.00 pm, most of the respondents experienced brightness *contrast* between the inside and outside. However, in the 12.00 pm – 2.00 pm and 2.00 pm – 4.00 pm periods, the respondents claimed that the brightness contrast level was between *average* to *not very contrast* (see Fig. 19).

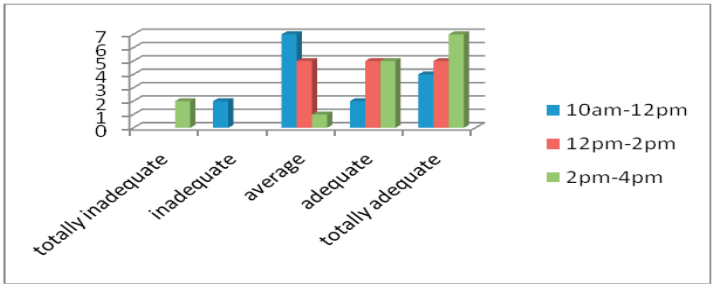

Fig. 20. Amount of view through windows

In the time period of 10.00 am – 12.00 pm, most of the respondents claimed that the amount of view through windows was between *average* to *adequate*. However, for respondents in the time periods of 12.00 pm – 2.00 pm and 2.00 pm – 4.00 pm, claimed that the amount of view through the window was *adequate* (see Fig.20).

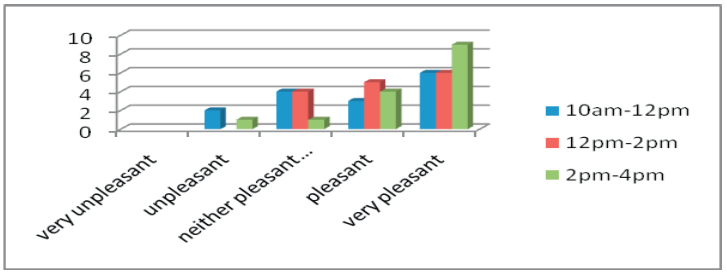

Fig. 21. Quality of view through windows

Overall, quality of view through the window was *pleasant* in all three (3) time periods, except in the time period of 2.00 pm – 4.00 pm, approximately 75% of the respondents claimed that they experienced *very pleasant* view (see Fig.21).

In summary from the questionnaire, most of the users felt very pleasant, and the daylight for writing and reading at the desktop was completely adequate between 12.00 pm to 2.00 pm. Between 10.00 am to 12.00 pm, most of the library users felt pleasant with the average amount of light in the library, but there was a contrast between the room and what they saw through the window, even though there was no strong glare from the window. While during 2.00 pm to 4.00 pm, according to the respondents, there was not enough daylight in the library but almost half of the respondents still felt pleasant due to the availability of artificial light, and there was no glare at all from the windows.

In conclusion, during 10.00 am to 12.00 pm, there was a brightness contrast between the room and what the user saw through the window. That was why most of the users of the library prefer to sit at the centre of the reading area rather than near the windows. The users preferred to sit near the windows, and near the atrium because the daylight at that time was very pleasant and completely adequate for writing and reading. While at 2.00 pm until 4.00 pm, users sat randomly because there was not enough daylight and they relied on the artificial lighting in the library at that time.

5. Conclusion

Daylight does affect the user's seating preference in Perpustakaan Raja Tun Uda Shah Alam where it was proven from the observation and questionnaire that have been done at the library. It also proved the hypothesis 1, where "library users prefer the seat near daylighted area, and they will stay longer", but the time spent in the library was not really affected by daylighting. It was shown in the observation that there was a significant relationship between amount of daylight and the seat chosen by the users of the library. From the questionnaire, more than half of the respondents which was 74% of them agreed that their seating preference affected by the daylight while, 37% of the respondent disagreed that daylight affects the amount of the time spent in the library.

Meanwhile, the hypothesis where "users are more comfortable at the space in library that has efficient daylighting", was not proven, because from the questionnaire during 10.00 am to 12.00 pm, 43% of the respondents felt pleasant with the average amount of light within the space at that time and during 12.00 pm to 2.00 pm, 47% of the respondents feel very pleasant with average amount of light of the space at that time. Thus, between 10.00 am to 2.00 pm, respondents felt very pleasant with the average amount of light in the library. While, at 2.00 pm until 4.00 pm, 44% of the respondents felt pleasant with the space although 56% of the respondents said that there was not enough light in the space. In conclusion, it is not true that users are comfortable at the space in the library that has more sunlight, because most of the users prefer the average amount of light than large amount of light in the library to do activities such as reading, writing and using computer. Generally, almost half of the users of the library felt pleasant with the lighting of the library and a huge numbers of respondents about 68% of them agreed that the design of the seating layout of the library optimizes daylight while, 37% of the respondents agreed that the design of the spaces to move around the library optimizes daylighting.

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